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**NAVAL POSTGRADUATE SCHOOL
Monterey, California**



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THESIS

**AN EVALUATION OF THE DOD INVENTORY
REDUCTION PLAN AND ITS EFFECTS ON INVENTORY
MANAGEMENT PRACTICES AT THE AVIATION
SUPPLY OFFICE AND FLEET READINESS AT
NADEP ALAMEDA**

by

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June, 1993

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93-25609



Unclassified

Security Classification of this page

REPORT DOCUMENTATION PAGE				
1a Report Security Classification: Unclassified			1b Restrictive Markings	
2a Security Classification Authority			3 Distribution/Availability of Report	
2b Declassification/Downgrading Schedule			Approved for public release; distribution is unlimited.	
4 Performing Organization Report Number(s)			5 Monitoring Organization Report Number(s)	
6a Name of Performing Organization Naval Postgraduate School		6b Office Symbol (if applicable) AS	7a Name of Monitoring Organization Naval Postgraduate School	
6c Address (city, state, and ZIP code) Monterey CA 93943-5000			7b Address (city, state, and ZIP code) Monterey CA 93943-5000	
8a Name of Funding/Sponsoring Organization		6b Office Symbol (if applicable)	9 Procurement Instrument Identification Number	
Address (city, state, and ZIP code)			10 Source of Funding Numbers	
			Program Element No	Project No
			Task No	Work Unit Accession No
11 Title (include security classification) AN EVALUATION OF THE DOD INVENTORY REDUCTION PLAN AND ITS EFFECTS ON INVENTORY MANAGEMENT PRACTICES AT THE AVIATION SUPPLY OFFICE AND FLEET READINESS AT NADEP ALAMEDA				
12 Personal Author(s) Derric T. White				
13a Type of Report Master's Thesis		13b Time Covered From To	14 Date of Report (year, month, day) June 1993	15 Page Count 69
16 Supplementary Notation The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.				
17 Cosati Codes			18 Subject Terms (continue on reverse if necessary and identify by block number)	
Field	Group	Subgroup	DoD Inventory Reduction Plan; Inventory Management; Aviation Supply Office (ASO); NADEP	
19 Abstract (continue on reverse if necessary and identify by block number)				
<p>The DoD Inventory Reduction Plan (IRP) was mandated by Congress in May 1990 to meet the challenge of re-sizing Defense inventories while maintaining the gains in readiness resulting from the defense strategy of the 1980's. This thesis is an evaluation of the effects of implementing the IRP on Navy inventory management practices at ASO, and on readiness at NADEP Alameda. "G" management (GMAN) reports and supply effectiveness data provided by FISC Oakland were utilized in making overall readiness and level of service determinations. The Navy's organization and major management initiatives relating to the IRP are also discussed. Finally, an assessment is made of what is currently being done by the private sector to reduce inventory levels and whether application of these systems and/or practices can be utilized by the military to reduce secondary item inventory levels.</p>				
20 Distribution/Availability of Abstract __ unclassified/unlimited __ same as report __ DTIC users			21 Abstract Security Classification Unclassified	
22a Name of Responsible Individual Prof. David G. Brown			22b Telephone (include Area Code) (408) 656-2464	22c Office Symbol AS/Bz

DD FORM 1473,84 MAR

83 APR edition may be used until exhausted

security classification of this page

All other editions are obsolete

Unclassified

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READINESS AT NADEP ALAMEDA

by

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Submitted in partial fulfillment
of the requirements for the degree of

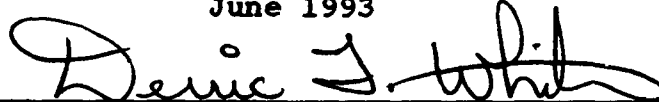
MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL

June 1993

Author:



Derric T. White

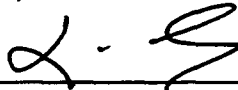
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ABSTRACT

The DoD Inventory Reduction Plan (IRP) was mandated by Congress in May 1990 to meet the challenge of re-sizing Defense inventories while maintaining the gains in readiness resulting from the defense strategy of the 1980's. This thesis is an evaluation of the effects of implementing the IRP on Navy inventory management practices at ASO, and on readiness at NADEP Alameda. "G" management (GMAN) reports and supply effectiveness data provided by FISC Oakland were utilized in making overall readiness and level of service determinations. The Navy's organization and major management initiatives relating to the IRP are also discussed. Finally, an assessment is made of what is currently being done by the private sector to reduce inventory levels and whether application of these systems and/or practices can be utilized by the military to reduce secondary item inventory levels.

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I. INTRODUCTION

This thesis is an evaluation of the Department of Defense (DoD) Inventory Reduction Plan (IRP) and its implementation effects on Naval inventory management procedures and fleet readiness. Inventory control or management systems, and practices utilized in private industry, will also be discussed and evaluated for feasibility of application to the DoD.

The thesis is divided into six chapters. Chapter I will present background information, purpose or scope of the thesis, research questions, methodology, and identify limitations of the study. Chapter II provides background information related to both the DoD and Department of the Navy (DoN) Inventory Reduction Plans. The program objectives and major management initiatives associated with the DoD and DoN IRP's, respectively, are also included.

Chapter III discusses the effect of the IRP on Naval inventory management practices at an inventory control point (ICP), and on readiness at an aviation depot repair facility. Information regarding the type of data utilized for readiness projections will also be included in Chapter III. Inventory management systems and practices used to effectively manage inventory levels in the private sector, and their potential usefulness to DoD, are discussed in Chapter IV. The final

chapter provides conclusions and recommendations for future work in this area.

A. BACKGROUND

The Defense strategy of the 1980's was focused on modernizing our forces while increasing the levels of readiness and staying power. This approach was seen as a means of correcting the technological obsolescence and shortages of spare parts which severely hindered operational readiness during the late 1970's. The combination of introducing new weapons and systems, modernizing current systems, and increasing support levels across the board led to the significant growth in inventory levels during the 1980's.

The material management system of the 20th century and beyond must continue to react rapidly and accurately when confronted with various threat scenarios. Our current challenge is to preserve that "readiness" capability as we downsize while simultaneously improving operations.

B. SCOPE OF THE THESIS

The objective of the study is twofold. First, the effects of implementing the IRP on Navy inventory management practices at an ICP, and on readiness at a Naval Aviation Depot (NADEP), are evaluated to determine the cost-effective benefits, if any, to the Navy of continuing operations in this manner.

Next, an assessment is conducted of what is currently being performed by the private sector to reduce inventory levels, and whether application of these practices can be utilized by the military to reduce "excess" inventories.

C. RESEARCH QUESTIONS

1. Primary Research Question

The primary research question of this thesis is:

Is the DoD Inventory Reduction Plan really accomplishing the objectives for which it was created, or has it actually resulted in increased costs and degraded the levels of readiness throughout the fleet?

2. Subsidiary Research Questions

The following subsidiary research questions are also examined:

- a. What specifically is encompassed in the mandated IRP? And what does the plan hope to achieve for the Department of Defense?
- b. What factors led to the conception and subsequent implementation of the plan?
- c. Has the IRP impacted readiness at Naval repair facilities? And, if so, at what costs?
- d. Can the DoD utilize commercial inventory management techniques to help decrease or prevent the recurrence of excess inventory levels?

D. METHODOLOGY

The overall approach was to initially document specifics of both the DoD and DoN reduction plans. Second, quantitative and qualitative data were gathered to evaluate the effects of implementing the IRP on a Navy depot repair facility and an

ICP. Finally, information pertaining to inventory reduction methodologies utilized in the private sector was researched and analyzed for its potential application to the military.

The information necessary to complete this study was obtained by utilizing four primary sources:

1. Navy Directives and Instructions. These informative documents provide the policies and procedures by which the operating forces function on a daily basis. Often voluminous and, at times, subject to the interpretation of those who implement them, they periodically leave one with an endless string of questions. These questions can often be answered or reinterpreted by the second source of information.

2. Interviews. Both in-person and telephone interviews were conducted with a variety of personnel. The majority of information for the study was obtained via phone conversations with personnel from offices and activities such as Office of the Assistant Secretary of Defense for Planning and Logistics (OASD(P&L)), Navy Supply Systems Command (NAVSUP), Aviation Supply Office (ASO), and Defense Logistics Agency (DLA). The material and production control personnel and supply system analysts at different levels of NADEP Alameda and Naval Supply Center (NSC) Oakland also proved to be excellent sources of information.

3. NADEP Alameda / NSC Oakland Reports and Records. The "G" management (GMAN) reports and supply effectiveness data

provided were crucial in making overall readiness and level of service determinations.

4. Reference Materials. Various sources of reference materials (i.e., Congressional hearings, Rand studies, GAO reports) were utilized to gain a broader perspective of the subject matter. In addition, numerous business periodicals were utilized to obtain the information necessary to evaluate commercial inventory management practices.

E. LIMITATIONS OF THE STUDY

The thesis will not provide an in-depth evaluation and analysis of the entire DoD Inventory Reduction Plan. The initial background information and program objectives presented do pertain to DoD components, but the primary focus, as will be seen throughout the remainder of the study, will be on the Department of the Navy. In particular, this thesis will not specifically address issues and procedures peculiar to the U.S. Army, U.S. Air Force or the U.S. Marine Corps.

During the research, it became evident that NADEP Alameda's cost accounting system currently does not capture the cost, duration, or nature of a material shortage delay in any of its assigned programs. Therefore, a more complete picture of the total costs associated with material shortages at the repair facility will not be achievable. The GMAN system and effectiveness data presented in Chapter III will

hopefully provide some indication of the overall effect of inventory shortages.

II. REVIEW OF INVENTORY MANAGEMENT PROGRAMS

A. BACKGROUND

During the late 1970's, the General Accounting Office (GAO) severely criticized the Department of Defense (DoD) for disposing of material that could be utilized on weapon systems or equipment that was still in its inventory, regardless of the number of years of supply on hand. A new policy requiring the retention of all material was responsively issued by DoD, with the understanding that a great deal of the secondary item materials¹ would be eventually migrating into inapplicable or unrequired inventory.² And with the introduction of new weapon systems, and the military buildup of the 1980's, secondary item inventory levels were definitely on the rise.

The amount of material needed for secondary item inventory is computed based on forecasted customer demand, known material requirements (such as scheduled maintenance), and war reserve stocks. DoD annually summarizes its secondary item inventory in the Supply System Inventory Report (SSIR). The

¹Principal items include such items as ships and aircraft, and secondary items include such items as spare and repair parts, fuel, construction materials, clothing, and medical and dental supplies.

²Inapplicable secondary item assets are those quantities of on-hand or on-order assets exceeding the established Approved Force Acquisition Objective (AFAO). These assets are termed inapplicable because there is no near-term need for the assets based on existing demand and program data.

SSIR is primarily a management tool used to monitor changes in the total secondary item inventory.

DoD secondary item inapplicable assets had more than doubled in value by Fiscal Year 1983 (FY83). As this trend continued, by FY88, roughly one dollar in three invested in on-hand inventories was invested in inapplicable inventory, and 1 dollar in 10 of on-order investment was for inapplicable assets. Table 1 shows that DoD-inapplicable on-hand assets increased from \$12.9 billion in FY83 to \$27.5 in FY88, an increase of approximately 113 percent. [Ref. 1]

Table 1

INAPPLICABLE ASSET GROWTH

(Current Dollars in Millions)

Asset Category	FY83	FY84	FY85	FY86	FY87	FY88
On-Hand	\$12,912 (29%)	\$15,527 (32%)	\$19,870 (31%)	\$25,621 (39%)	\$26,630 (35%)	\$27,477 (35%)
On-Order	\$1,811 (9%)	\$2,528 (11%)	\$3,909 (12%)	\$4,148 (13%)	\$4,962 (16%)	\$2,945 (11%)

Source: Service/DLA Stratification Data

() = Percent of Total On-Hand or Total On-Order Assets.

In FY83, as shown above, roughly 29 percent of total on-hand inventories were inapplicable. However, by FY88 approximately 35 percent of the inventories were inapplicable. Comparable data is also shown for the on-order assets. The dollar value of the inapplicable on-order assets increased

from \$1.8 billion to \$2.9 billion in FY88, an increase of approximately 61 percent. In other words, the total DoD on-order assets, which were inapplicable based on dollar value, increased from 9 to 11 percent during the FY83 to FY88 time frame. [Ref. 1:p. 19]

In November 1989, at the same time the Berlin Wall fell, the Secretary of Defense sent a Defense Management Report to the President. The report contained management initiatives to streamline DoD's current business practices. To characterize the submission of the report as timely, would be an understatement, as the public began to openly criticize the Defense Department for "...having wasted tens of billions of dollars filling its warehouses with stockpiles of items ranging from submarine spare parts to hospital gowns--things the military doesn't need and, in some cases, doesn't even know it has purchased" [Ref. 2].

On March 6, 1990 Senator John Glenn, Chairman of the Committee on Government Affairs of the United States Senate, presided over a hearing which discussed the "serious condition" of the Department of Defense's management of its supply system. After completion of numerous investigations, conducted by the GAO and Office of Management and Budget (OMB), which focused on the consistent growth of DoD inventories, its supply system had been labeled a "high risk" area. GAO, in particular, during various 1990 investigations,

concluded that DoD had \$34 billion worth of unrequired inventory on hand[Ref. 3].

GAO's evaluation of the growth in aircraft unrequired inventories, for example, showed that the most common causes for the growth were overestimated use/demand rates and modification of existing aircraft and equipment [Ref. 4]. Also identified, as major causes for unrequired inventory in ship and submarine parts, were requirements that did not materialize, deactivation of older ships, and replacement and phasing out of equipment [Ref. 5]. The above factors also extend to other systems and equipment types as well.

The Navy uses two years of historical use data to develop demand forecasts for items in the supply system. Normally, factors such as failure rate and field versus depot repair are considered when computing the forecasts. However, new items entering the supply system or items undergoing engineering or design changes do not have past use data that represent future requirements.

Therefore, demand rates are based on information from maintenance, contractor, and user personnel or the demand rates of similar items. If demand rates are wrong, requirements will either be overstated or understated. Modification programs, which usually correct deficiencies or improve capabilities of weapons systems and equipment, involve replacing items typically managed by the services. During a

modification program, requirements for old or replaced items decrease while requirements for new installed parts increase.

There are obviously many other reasons for the increasing levels of unrequired stock including: weapon systems, system components and aircraft being phased out, improvement in parts reliability, and reductions in war reserve or safety stock levels. The reasons behind the increasing levels were evident, but solutions to lowering the levels were not quite so apparent.

The DoD inventory remains the largest in the world. Composed of nearly five million line items, the inventory includes material valued at approximately \$109 billion. This material provides replacement parts and other consumable items to maintain the readiness of our ships, aircraft, tanks, and other complex weapons systems used by our military forces and for military personnel support needs.

Recent events in the Persian Gulf and Panama have shown that the DoD material management system was then prepared to meet recurring supply system demands. But major changes over the past few years, concerning the threat facing the United States and our allies, have also highlighted the need for a smaller more "flexible" material management system, capable of rapidly responding to various threat scenarios.

Given the future uncertainties, the Department of Defense must begin to limit purchasing to smaller quantities until future needs are better defined. As Chairman Glenn reiterated

during subsequent Congressional hearings, "DoD is buying more than it needs, what it is buying is often substandard and not to specifications, and it doesn't seem to be able to adequately account for or control what it has." [Ref. 3:p. 2] In addition, Mr. Frank C. Conahan, then Assistant Comptroller General, National Security and International Affairs Division, U.S. General Accounting Office, addressing an earlier committee stated:

Although in our work we found no dominant reason to cause inventory growth, we believe the growth results from a tendency to stock far into the future. This is fostered by a management philosophy that rewards obligating funds and filling orders. There is no corresponding emphasis on economy or efficiency.[Ref. 6]

Opinions may have varied somewhat as to the primary cause of increasing levels of inventory growth. Nevertheless, in May 1990, Congress reached a consensus and mandated the implementation of the DoD Inventory Management Program.

The Material Management Board (MMB)³, which would be chaired by the Deputy Assistant Secretary of Defense (Logistics), was established to recognize the requirement for top-level DoD coordination of the program. One of many functions of the MMB was to oversee management of the DoD-wide Inventory Reduction Plan.

³The MMB provides the Secretary of Defense and his staff a mechanism for operational oversight to direct implementation of Defense material management initiatives and programs.

In addition to the emphasis placed on the MMB, three elements, which were contained in the Secretary of Defense's Defense Management Report, and considered essential to the success of the reduction program, include:

1. Moving toward a new and more efficient organization for managing the DoD Supply System;
2. Establishing an improved, integrated information management system through DoD's Corporate Information Management (CIM) effort;
3. Implementing a series of policy and functional management improvements and applying technology to provide greater support at a lower cost with smaller inventories.[Ref. 7]

The primary focus of the DoD Inventory Reduction Plan is embedded in the third element above.

B. PROGRAM OBJECTIVES OF THE IRP

The overall goal of the DoD Inventory Reduction Plan, quite simply, is to reduce the Department's cost of doing business. If all goes according to schedule, the plan is designed to save \$18 billion by FY97. The IRP is designed to determine the appropriate size of DoD material inventories, reduce annual material budget requirements in a systematic manner, and preserve weapon system and personnel readiness. The success of this plan is an essential element of the Department's overall program to effectively manage future

force reductions, changes in operating tempos, base closures, and budget reductions.

The IRP includes all phases of material management from the introduction of an item into the supply system through weapon system retirement. The five specific objectives which the plan is expected to achieve are to:

- Minimize the Quantity of New Items Entering the Supply System.
- Reduce the Number of Items Currently in the System.
- Reduce the Quantities of Material Stocked.
- Pursue Commercial Alternatives to Material Stockage.
- Improve Material Control and Asset Visibility.[Ref. 3:p. 138]

Minimizing the quantity of new items entering the Supply System will definitely be a challenge. This objective will require a complete revamping of the military acquisition maxim of procuring the most technologically advanced system possible. From this point on, more emphasis will need to be placed on obtaining the Best Available Technology (BAT), that is, systems that will be easier to maintain, are more reliable, and are more compatible with existing technology. This should result in lower overall unit costs, yet increase all levels of operational readiness.

Reducing the number of or disposing of items currently in the system will need to be monitored closely. The future redesign of systems, equipment, and their components will

require DoD to carefully examine tradeoffs associated with all costs involved. The primary focus should be on reducing current levels of inventory and those costs associated with redesign or additional procurement of "dual" purpose components.

Obviously, reducing the quantity of material stocked will be a move in the right direction, as long as readiness standards are maintained. The primary material management concept being utilized in private industry to achieve this objective is the Just-In-Time (JIT) method. The possibility of successfully utilizing this or similar programs, in a military environment, will depend, to a great extent, on the ability of the services and their suppliers to develop positive working relationships with one another. Issues related to DoD potentially implementing the above management technique is more fully discussed in a later chapter.

In addition to reducing the number of items currently in the system, we must also exercise extreme caution in regard to pursuing commercial alternatives to satisfy material shortages. If the government is not careful, it could very well end up applying the savings achieved from stocking less inventory to those acquisition costs associated with commercial procurement. The procurement of \$400 hammers and \$2,000 ash trays are two examples that quickly come to mind.

When the government finds itself in a situation where it has an unexpected increase in demand, for an item that has

suddenly become "critical," it can usually expect to pay a much higher price to acquire that item. Especially, when the item is only available under a previously expired sole source contract. The expensive stockage costs could be attributed to high Research and Development (R&D) costs that were incurred to produce the item or the sophisticated technology associated with the item. The ability of the suppliers to provide required items during wartime, as well as peacetime situations, must also be considered.

Improving the control and visibility of inventory items will definitely benefit all concerned parties in the acquisition process. The Gulf War demonstrated the fact that everyone involved in the material management process needs better and more timely information on the location of inventory. Better visibility of assets will provide two key benefits. First, it will prevent the procurement of new material when it is available at other activities or in another Service. Secondly, better visibility will ensure that we can locate material anywhere in the storage or transportation system to fill high-priority requisitions quickly.

C. NAVY'S ORGANIZATION FOR IRP

This section provides a brief synopsis of the function of the Navy's Inventory Management Improvement Plan (IMIP), its goals, and key personnel associated with its administration.

In addition, areas being impacted by improving interpersonal working relationships within the Navy's Inventory Control Points (ICP's) will also be addressed.

1. Management Organization and the IMIP

The Navy manages the DoD Inventory Reduction Plan (IRP) within its Inventory Management Improvement Plan, which was initiated by the Navy in 1988 to analyze and reduce significantly high levels of secondary item inapplicable inventory. As mentioned earlier, inventory levels increased consistently during the 1980's. Management's emphasis, during this time, was focused on force growth and modernization, readiness improvement, material accountability and the introduction of automated data processing (ADP) systems which would hopefully improve the efficiency of operations.

DoD's moratorium on the disposal of obsolete/excess material, in conjunction with the Navy's focus on improvement, inevitably resulted in increased inventory levels. It was the growth of the Navy's secondary item inventories that resulted in the initiation of the IMIP. The IMIP was intentionally designed to get top managements attention and bring innovative ideas to bear on the problem of inventory growth. The IMIP initially had only three goals: reduce inapplicable inventory, preclude the introduction of additional inapplicable inventory and address the underlying causes of inapplicable inventory[Ref. 8].

A Navy flag officer assigned as the Deputy Commander for Fleet Logistics Operations in the Naval Supply Systems Command (NAVSUP) directly administers the IMIP. Other top logistics managers from the Naval Supply Systems Command, Office of Naval Personnel (OPNAV), Assistant Secretary of the Navy for Research, Design and Analysis (ASN(R,D&A)), Hardware Systems Commands, Fleet Commands, Inventory Control Points and Supply Centers have actively participated in the program.

Defense Management Report Decisions (DMRDs) 901 and 987 contain the estimated savings (\$18 Billion) and other financial goals associated with the programs. Individual proponents have been identified for each DMRD initiative and are being held responsible and accountable for pursuing the effective implementation of each DMRD and the achievement of projected savings. NAVSUP has been designated as the proponent for the Navy Inventory Reduction Plan. The NAVSUP Deputy Commander for Financial Management and Comptroller is the proponent point of contact. Progress on the initiatives is reviewed quarterly.

During FY91, the Under Secretary of the Navy directed the Auditor General (Navy) to begin a detailed review of all DMRDs. The purpose of the review was to determine whether the implementation plans were workable and to assure that all necessary and appropriate management actions were being pursued to achieve projected savings. In the case of DMRD 901 initiatives, which deal with reducing supply system cost and

contribute the vast majority of Navy IRP savings, results verified that Plans of Action & Milestones (POA&Ms) and a savings tracking system were in place and that savings estimates were realistic and achievable.[Ref. 9]

2. Cultural Change

The Navy's incorporation of Total Quality Management principles, in relation to inventory management, has resulted in the implementation of a cultural change which is being aggressively pursued. Significant strides are being made daily, and Navy managers are continually focusing their efforts on improving interpersonal working relationships up and down the chain of command. Areas in which the inventory managers' culture at the two Navy ICPs, Aviation Supply Office (ASO) and Ships Parts Control Center (SPCC), have been impacted are as follows:

- Performance appraisals specifically address supply system improvements.
- Functional training has been improved.
- Rewards and incentives are fostering employee commitment to continuous improvement.
- Item managers have been empowered with the authority and tools to make better support decisions. They have been given increased control over assets.
- Performance measurements focus on cost-effective operations. Corporate goals are clearly defined and understandable at the lowest level of the organization.[Ref. 8:p. 2]

Results, taken from a random survey of inventory managers during SPCC's command inspection (23 October - 08 November 1991), showed a definite trend toward a change in inventory management philosophy. SPCC's command inspection team believed that appropriate emphasis is now being placed on command inventory reduction objectives.[Ref. 8: p. 2]

D. NAVY MAJOR MANAGEMENT INITIATIVES

The Navy's primary mechanisms for reducing its levels of secondary item inventories, and accomplishing the goals of addressing causative factors, precluding new inactive inventory, and reducing inactive inventory, are contained in five major management initiatives. These management initiatives, which are tied to Defense Management Report Decisions 901 and 987, are as follows:

1. Project Boss
2. Reduced Acquisition Lead Time
3. Reduced Intermediate Inventories
4. Reduced Consumer Inventories
5. Reliability Improvements[Ref. 8:p. 15-19]

The Navy's Buy Our Spares Smart (BOSS) Program is designed to reduce the total cost of spares simply by increasing the competitive procurement associated with the particular items being purchased. Navy policy now allows the use of available

funding to purchase the technical data and drawings through the stock funds accounts. This change gives supply managers the ability to obtain the information necessary to breakout sole source contracts by developing competitive sources for previously sole source items. Project BOSS resulted in FY91 outlay savings of \$166 million[Ref. 8:p. 15]

The objective behind reducing the acquisition or procurement lead time is to reduce the overall inventory levels. Different initiatives, such as using electronic data interchange (EDI), reducing contract terminations and even expanding multiple-year contracting, are currently being utilized by the Navy to negotiate better delivery lead times with suppliers. The Navy established an initial program goal of 25 percent reduction in lead times. Reduced acquisition lead times will definitely reduce future obsolescence costs, resulting in greater inventory savings.

The concept of total asset visibility (TAV) comes into play when discussing reduction of intermediate inventories. TAV will enable the lateral redistribution of assets above the requisitioning objective (i.e., excess material). Expanded asset visibility will lead to reduced supply costs as a result of an inventory requirements reduction. Unfortunately, as intermediate inventories are minimized or eliminated, the potential for further savings will decline.

By reducing consumer inventory levels, the remaining assets will be optimized to achieve the proper balance between

investment and readiness. As a result, current aviation and ship allowance baselines (AVCAL's and COSAL's) will be reduced. Another method of reducing consumer inventories is to avoid purchasing items when ships are decommissioning. And the use of readiness-based sparing models should also be considered for specifying lower stockage levels.

Navy reliability improvement initiatives focus on product improvements or engineering changes that will decrease equipment failure rates and, therefore, reduce logistics support costs. New Navy policy allows stock fund investment in reliability and maintainability improvements as long as that investment results in decreased requirements for spares and/or reduced logistics support costs.

With respect to secondary item inventory levels, Navy inventories were valued at \$22.6 billion at the end of FY91, down \$7.0 billion from 1990. The projected inventory for the end of FY97 is \$14.4 billion, a further decrease of \$8.2 billion. In FY91, the Navy exceeded its savings goal by \$86 million, having achieved a savings of \$202 million. [Ref. 9:p. 56]

III. EFFECT OF THE IRP ON INVENTORY MGMT AND READINESS

A. INTRODUCTION

This chapter discusses the effect of implementing the DoD Inventory Reduction Plan (IRP) on two separate Naval activities. First, measures being taken by the Aviation Supply Office, one of the Navy's inventory control points (ICP's), are examined to determine their effectiveness in reducing current and future levels of secondary item inventory.

The effect of material shortages, possibly caused by insufficient inventory being on the shelf, is next evaluated to determine the effect on production at the Naval Aviation Depot (NADEP) in Alameda. This evaluation is primarily based on NADEP Alameda's management of Condition Code "G" materials and their associated costs. In addition, readiness is evaluated based on the level of service, from a material availability standpoint.

B. REDUCTION PLAN FOR AVIATION SPARES

The Aviation Supply Office (ASO) has implemented a five year "savings" plan that management believes will reduce the level of spare parts required for fleet support, thus enabling it to meet savings goals imposed by Defense Management Review

901. ASO's strategy called for the majority of the management savings to be accomplished:

- through shorter procurement lead times with better forecasting,
- through reduction in retail echelons made possible by better models and better availability of information,
- through targeted improvements in reliability which prevent untimely failures, and
- through the use of managerial alternatives to buying spares, including reducing depot repair turn-around-time, and repairing items that are now considered consumables.[Ref. 10]

The above programs are expected to "avoid buying" and are projected to save \$1.936 billion in net obligations. Competition is projected to double the amount of competitive procurements which currently exist in ASO's annual buying base. This will also result in substantial increases in the level of savings.

In the area of production lead time ASO definitely has room for improvement. A 1991 General Accounting Office (GAO) report stated:

The Navy's Aviation Supply Office could improve determinations of procurement lead time requirements for aviation parts. Administrative lead time requirements were not always based on actual experience. At one point, the Aviation Supply Office had arbitrarily increased the administrative lead times for all items by 9 months. In calculating production lead time requirements, the supply office did not consider some actual experienced lead times even when these lead times were more realistic. It also did not routinely obtain contractor estimates of lead times or compare them with actual performance.[Ref. 11]

The production leadtime in the ASO database currently approximates 150 days. This is a reduction from previously established time frames, and based on empirical studies⁴, should result in outlay savings as a derivative result of reduced obsolescence.[Ref. 12] ASO is making the assumption that they can avoid roughly 25% of the obsolescence costs that are currently being charged to their customers through Navy Stock Fund (NSF) surcharges.

Based on a recent study completed by the Center for Naval Analysis, which recommended the use of the ARROWS model⁵ for requirements determination, ASO has taken a 10% reduction in the value of new spares required for ships and stations.[Ref. 10] This reduction in the cost of allowances will be applied to out-year provisioning of repairables and consumables. Yes, this action will obviously result in additional savings to ASO, but at what cost?

By reducing the numbers of spares on the front end of the procurement process, ASO could possibly be setting itself up

⁴Based on a May 1990 GAO report, it was determined that overstated lead times caused increased investment for larger inventories, increased the chances of buying excess material, and increased termination costs if requirements changed. Understated lead times can cause shortages of needed supplies, which could affect the operational readiness of weapon systems or their components.

⁵The ARROWS model is the approved Readiness Based Sparing (RBS) model. However, the use of ARROWS for actual allowance computation requires approval from NAVSUP and OPNAV. ARROWS is designed to compute consumer level requirements, i.e., Aviation Consolidated Allowance (AVCAL) quantities.

for potential supply shortfalls in the long haul. Instead of saving dollars, this could result in expensive re-procurement costs and increased leadtime for receipt of parts.

As the majority of repair contracts begin to convert from Government Furnished Equipment (GFE) to Contractor Furnished Equipment (CFE), ASO has assumed that the quality of the forecasting will improve. They have estimated the cost advantage at a cumulative 1% of the material cost of repairs over the five years.

Building a strong Value Engineering Change Proposal (VECP) program at ASO is strongly considered to be a long term base from which to make constant reliability improvements. The savings are projected to come from two sources in the area of repair; the reliability investment in the procurement of repairables will avoid repair costs as will the direct investment in better repair methods.

The VECP program is a definite move in the right direction. The savings which can be realized if this program is handled properly are quite good. If a vendor or contractor proposal is submitted and accepted, the Value Engineering clause will provide for the contractor to share in:

1. The savings generated on the contract being performed-- "instant contract savings,"
2. Savings on concurrent contracts for essentially the same items--"concurrent contract savings,"
3. Savings on future contracts--"future contract savings," and,

4. Savings of the Government in operation, maintenance, logistic support, or Government property resulting from the value engineering change--"collateral savings." [Ref. 13]

In regard to Turn-Around-Time (TAT), ASO envisions savings or cost avoidance to be obtained by not having to buy the repairables needed for the longer TAT. Anticipated management changes in the NADEP's and investment of \$100 million in piece parts to more closely align the depot level performance with the pattern in Intermediate Maintenance Activities (IMA's) is considered by ASO to be the driving force behind this initiative. The effort to reduce TAT is substantiated by a RAND Corporation effort funded by NAVSUP/NAVAIR and the Assistant Secretary of the Navy. [Ref. 10: p. 3]

Another initiative in which ASO will require the developmental assistance of Naval Air Systems Command (NAVAIR) relates to the repair of consumables. ASO assumes that up to 20% of the dollar value of consumable items can be re-used at an average of 50% of the cost of buying new items. The Aviation Supply Office envisions finding low overhead repair shops to repair items at \$20-25 per labor hour versus the \$50-75 which would be charged at major commercial or organic sites. Alternatively, ASO would utilize Intermediate Maintenance Activities on a cost reimbursement basis, focusing on the high cost, high usage items that drive demand.

When you consider the facts, the above initiative seems quite feasible. Our foreign allies have long been reporting repair, reclamation, and refurbishment on items the Navy regards as consumables. And with repairables generally being repaired at a cost of 25 cents on a dollar, one can't help but think of the savings which are possible.

The last element to be addressed in regard to ASO's reduction plan for aviation spares focuses on competition. The main impediments to competitive buying are design stability, configuration control, and the existence of a government owned technical support package.[Ref. 10: p. 5] ASO appears to have overcome all obstacles relating to these impediments. Over the past five years the Aviation Supply Office has recorded savings of over \$600 million on first time competitive buying of previously sole-source items. That experience has lead to 30% cost savings when the breakout is to unrestricted competition and a 17% savings when the breakout is from prime contractor to original equipment manufacturer.[Ref. 10:p. 5]

As stated above, all of the ASO cost or inventory reduction initiatives are estimated to result in savings of approximately 1.438 billion over the next five years. It will definitely be interesting to see the bottomline in FY95.

C. EFFECT OF MATERIAL SHORTAGES AT A NADEP

This section takes a close look at the effect material shortages (due to lack of sufficient inventory) are having on the production process at the Naval Aviation Depot (NADEP) in Alameda. In particular, Condition Code "G" repairable components are evaluated in an attempt to ascertain what the Navy should do to prevent the continued spending of millions of dollars for material that is not responsively supporting the fleet.

1. Material Pipeline

A major effect of a material shortage might be seen as the reduction of output into the distribution channel. Another way to view this is to compare a Navy repair depot to any industrial plant: the depot will only be paid when repairs are completed and engines are returned to the supply system in ready-for-issue (RFI) condition. If output is restricted, less material is available for sales to its customers.

The Navy material pipeline, or distribution channel, is comprised of RFI material and also not ready for issue (NRFI) assets awaiting repairs. If an inventory manager is attempting to achieve a set rate of supply effectiveness, he can determine the number of RFI items required to support fleet assets. The RFI portion of the pipeline, at this point, may be considered fixed. It then becomes quite obvious that

the pipeline becomes longer as the total repair time increases.

A material shortage, or lack of ready assets, may affect the pipeline in several ways. The shortage can quickly cause a decrease in the production rate by increasing the total time that the item remains unserviceable and therefore unavailable for issue to customers. In order to maintain a given level of supply effectiveness, the inventory manager must maintain a higher level of system assets than would be necessary if no production delays existed. The pipeline costs are the investment costs and holding costs of the level of inventory.

For years the situation described above has been standard routine for stock points and supply centers throughout DoD. Have procedures really changed with the advent of the IRP, or is it still "business as usual" in regard to inventory or materials management? In the next section, we focus on the production flow at a NADEP and discuss the effect of having too few, as opposed to an excess of, on-hand repair parts.

2. Description of maintenance

This section begins with an overview of the production flow process for an aircraft, at a NADEP, prior to discussing the effect of a material shortage. The researcher found it

extremely beneficial to have a working knowledge of how the aircraft process worked.

The production flow during Standard Depot Level Maintenance (SDLM) varies considerably depending on the type of aircraft, engines, and components scheduled to be reworked. Workload planning conferences are usually held two to three quarters prior to inducting the aircraft or components, but schedules are usually subject to revision at any time. During the aircraft rework phase, a line is usually set up in one or two hangars and the aircraft physically moves through the stations in the line. Each station is assigned specific tasks to accomplish as the aircraft is moving through.

As the aircraft proceeds through the hangar, it is stripped of all components scheduled to be repaired or replaced. Those items which are repairable are sent to component repair, or the "feeder." Although it varies considerably between types of aircraft and individual aircraft themselves, approximately 300 to 400 components usually fall into this category. Another 1000 components, however, are removed to provide working access to the airframe or other components in need of repair.

These "removed for access" components are stored until the aircraft is ready to be reassembled. About this time the reworked or new components should be arriving for eventual reinstallation in the aircraft. Standard procedure dictates

that, as far as possible, all components be reinstalled in the same aircraft from which they were removed.

The process flow described above is different for a component, yet quite similar for an engine. Descriptions of these two processes are excluded because they are beyond the scope of this study. Now, the question of what to do during a material shortage needs to be answered.

During SDLM, material shortages are usually abated through two forms of cannibalization: diversion, and backrobbing. Diversion is the reassigning of an RFI asset from one aircraft (or component or engine) to another. Any components removed for access only, in addition to, newly purchased parts may be diverted to any aircraft that might require them.

Material and production control personnel at the NADEP stated that diversions occurred "quite frequently," yet presented little, if any, negative effects to the production process. Occasionally, a small amount of administrative effort is required to track the diversion so that, eventually, each aircraft ends up with the right parts. To the researcher's disbelief, no formal statistical data is being maintained regarding the frequency of diversions or on those particular parts being diverted.

Backrobbing, although remotely similar, differs from diversion in that the parts required are currently installed on an aircraft and are only removed to satisfy an emergent

requirement. For example, if a completed aircraft is on the flight line for final predelivery testing, and suddenly has a problem with its main landing gear, the NADEP will backrob a replacement set of gear from an aircraft in process if there are no RFI assets available. As with diversions, no quantitative or qualitative information is logged concerning backrobbings.

3. Condition Code "G" Repairable Components

After the NADEP's artisan (maintenance technician) has screened the Navy Industrial Fund (NIF) store, and exhausted all means (i.e., diversion, backrobbing) of obtaining material shortages, he submits a requisition for each required item through the Production Control Center (PCC) and Material Resource Branch. The requisitions are screened and then entered into the supply system. In actuality, this procedure should be reversed. That is to say, the system should be exhausted prior to diverting or backrobbing, but this usually isn't the case.

Once supply system status on requisitioned material indicates that 100% of the required material, for a particular component, will not be available within 45 days of the requisition date, that component automatically migrates to "G" condition. In accordance with NAVAIRINST 4440.6D, a "G" condition component is defined as a repairable component

suspended from depot level rework due to a shortage of one or more repair parts[Ref. 14]

When a component has been designated in "G" condition, NADEP Alameda provides NSC Oakland, the Designated Supply Point (DSP), with updated status on all parts requirements, prior to physical transfer of the repairable component to the DSP. The Designated Supply Point is responsible, at this point, for tracking and expediting the requisitions which are driving the component to "G" condition. The components are preserved and packaged, prior to "G" condition storage, by NSC Oakland. In addition to these costs, NSC Oakland is also responsible for transportation expenses related to the component.

"G" condition material usually remains with the DSP until all of the parts are available, at which time the component is reinducted. NADEP Alameda would only keep the "G" condition component if its size and/or disassembled state made it virtually impractical to transfer.

Reinduction of the component, after all of the bit and piece parts are available, should be done within two weeks, if the NADEP isn't at full plant capacity with high priority work, and the item has a repair requirement and is not in a "due-in long supply" status (parts which are expected to be received in the near future)[Ref. 13:p. 6]. Table 2 provides a picture of "G" condition material status data at NSC Oakland

for the months of FEB 93 through APR 93 based on the "G" Management (GMAN) Report.

Table 2

G CONDITION MATERIAL STATUS

	<u>FEB</u>	<u>MAR</u>	<u>APR</u>
<u>G Condition Components</u>			
Number of Components	124	109	140
Number Awaiting Reinduction	19	15	5
% Awaiting Reinduction	15.3	13.8	3.6
<u>Bit Piece Requirements</u>			
Due In	348	230	404
<u>Dollar Value of G Condition Material</u> (\$ millions)			
Components	3.1	3.6	4.2
Bit Piece Parts	.45	.50	.44

Of particular interest in Table 2, is the fact that the month of MAR showed a decrease from FEB, in both the number of components migrating to "G" condition, and in the number of bit piece parts due in. Yet, the dollar value of "G" condition material is steadily increasing at approximately 16 to 17 percent each month. The bit piece part requirements reflect the total quantity of parts due in each month for all components in an Awaiting Parts (AWP) status. Once all bit

piece parts are received, the "G" condition component goes from AWP to AWI (Awaiting Reinduction) status.

Also noteworthy, is the consistent decrease in the percentage of "G" condition components awaiting reinduction, especially in the month of April. The total dollar value of all components in "G" condition, as of 13 May 93 (the run date of the data package) was well over \$84.0 million (not listed in Table 2). Likewise, the total number of "G" condition components and those awaiting reinduction on 13 May, were 2,457 and 815, respectively. That means that at least a third of all NADEP Alameda/NSC Oakland "G" condition components are ready to be reinducted but are instead sitting around accumulating additional holding or storage costs and a lot of dust.

4. Material Availability

Based on the statistical data presented above, the question of the possible lack of material support being provided to the NADEP certainly enters ones mind. Material shortages, from a supply standpoint, usually occur for one of the following reasons:

- Material which is available locally may not be delivered quickly causing unnecessary days of delay in the production process
- Material may not be available locally even though it is available within the Navy's supply system. This type of shortage causes delays as the material is shipped to the NADEP.

- Material may not be available in the supply system at all. This situation requires a procurement action (which means leadtime), a manufacturer's production run (with its leadtime), and shipping time. It could be several months to years before this material is available and in the system.

The question of material availability, in a nutshell, boils down to one of stocking policies and procedures. The researcher, in an attempt to determine the level of material availability currently being provided to NADEP Alameda, requested Point of Entry (POE) effectiveness data from NSC Oakland, for the major technical cogs being provided to the NADEP. The information provided, for the quarter JAN 93 to FEB 93, is displayed in Table 3.

Table 3

POINT OF ENTRY DEMANDS / EFFECTIVENESS

(Net Effectiveness for NADEP Alameda)

<u>COG</u>	<u>JAN</u>	<u>FEB</u>	<u>MAR</u>
9C	180/95.6%	179/90.5%	140/92.9%
9G	80/95.0%	191/94.8%	73/94.5%
9N	158/90.5%	499/96.4%	343/96.5%
9Z	87/87.4%	180/93.3%	205/95.6%

The Cognizance symbols (COG's) contained in column one of Table 3 are two character numeric-alpha codes that are

normally prefixed to national stock numbers to identify and designate the cognizant inventory manager who exercises supply management over specified categories of material. All 9__Cogs denote Navy owned material that is managed by Navy Fleet Material Support Office (FMSO). [Ref. 15] The point of entry data, in the remaining columns of Table 3, provides the total number of requisitions (demands) by COG that NSC Oakland received each month, followed by the net effectiveness or percentage of the demands that were issued/satisfied immediately (off the shelf). For example, in the month of January for (9C) COG items, 95.6% of the total 180 requisitions received by NSC Oakland were issued from stock on-hand to NADEP Alameda.

The data in Table 3 indicates, at least on paper, that NSC Oakland is filling a very high percentage of the demands received from the NADEP. This information seems to conflict, at first glance, with the "G" condition data discussed above. One might presume that if material availability were of the quality indicated by Table 3, that total dollar value and quantity of "G" condition components would not be at their present levels.

In order to put this into perspective, let's consider the repair of a particular component which requires five different parts. Let's also assume that whether NSC Oakland has a particular part is completely independent of it having any other part (probabilisticly). This would make the

probability of having all five parts equal to the product of each separate probability. For example, using the JAN 93 effectiveness of .874 for the 9Z cog, the probability of the NADEP receiving all five parts from NSC Oakland is $(.874)^5$ or .5099.

In other words, there would be a little better than a 50% chance of obtaining all five parts. The current standard for Supply Material Availability (SMA) is 85%. This only attempts to highlight the seriousness of material availability and its importance to the overall industrial effort.

5. Analysis

The above information relating to material availability and "G" condition material can't help but leave the impression that the Navy needs to take immediate action to combat the material shortage problem which exists in its NADEPs. The researcher is making the assertion that this is not a NADEP Alameda problem only. This statement is based on research gathered regarding other NADEP's, and from conversations held with NADEP Alameda/NSC Oakland personnel.

Clearly, the Navy's investment in unserviceable components is quite substantial, yet the fact remains that something drastic needs to be done about the lack of readily available assets in the system. This raises the possibility that the DoD Inventory Reduction Plan may be moving the Navy in the wrong direction. If the Navy can't adequately manage

its inventories to support the fleet now, how can the Navy expect to do so with fewer parts on the shelves in the future.

Obviously, the Navy has to learn to do a better job of managing its assets in the years ahead. The next chapter evaluates inventory management practices, which are being utilized in the private sector, to effectively manage and reduce excess inventory levels. The potential application of these methodologies, to improve the way the Navy is currently managing its supply assets, is also addressed.

IV. PRIVATE SECTOR INVENTORY MGMT SYSTEMS AND PRACTICES

A. INTRODUCTION

The concept of inventory management held by Corporate America began to change drastically in the late 1970's and early 1980's. The belief that inventory levels should be maintained at the lowest possible level, and be consistent with the operation it supported, was soon accepted as good business practice throughout industry. Companies quickly began eliminating contingency stocks that had always been maintained in the past.

Most companies today that have completely adopted the philosophy of maintaining minimum inventory levels believe that if excess levels of stock are maintained it only ends up resulting in various types of inefficiencies for the entire operation. Excess inventory is being viewed as a cost that inevitably reduces current and future profits since it increases carrying costs and potential write-offs for obsolescence and damage.

However, companies are quick to point out that reduced inventory levels don't just happen on their own. One common theme underlying all successful operations, is that you must have inventory reduction goals. Most companies today emphasize the fact that inventory reduction goals and changes

associated with inventory management should be a continuous process, not a one-time program.

The next section will present two of the more prominent inventory control systems currently being utilized in the private sector today: Manufacturing Resource Planning II (MRP II), and Just-In-Time[Ref. 16]. Of the two control systems mentioned, Just-In-Time is by far the more popular concept and is associated with the phrase "zero inventory."

B. INVENTORY CONTROL SYSTEMS

1. Manufacturing Resource Planning II

MRP II is a total management/departmental process geared to controlling a manufacturing company's resources. It is a three part system that begins with materials requirements planning, extends this to production resources and finally updates itself through a feedback loop.[Ref. 14]

There are a number of specific prerequisites upon which a MRP II system is based. First, a master production schedule must exist for the independent demand item and it must be able to be stated in a bill of materials. Second, the bill of materials must precisely identify each inventory item by a unique code and be extendible throughout the process. That is to say, each new sub-assembly takes on its own part number as production continues.

Next, the bill of materials must not only be structured to reflect the manner in which the product is

assembled but must list all the components of a given product as well. The last prerequisite requires that inventory records be available for all items under the system's control, and that these records be accurate, complete, and up-to-date if the MRP system is to be useful.

In addition to the prerequisites above, there are four basic assumptions that are made by the system:

1. Lead times for all inventory items are known and have fixed values.
2. Each inventory item in the system goes into and out of stock. This allows the manufacturing process to be monitored from one stage to the next.
3. All components of an assembly must be available at the time of assembly on the production line.
4. All work centers have unlimited capacity.[Ref. 14]

At this point, assuming all prerequisites have been met, the mechanics of the process begins. MRP II takes the master production schedule and determines the number of end items needed in each time period. The bill of materials takes this figure and determines the gross requirements for all materials. Next, the net requirements are calculated by adjusting the gross requirements for materials on hand by using the current inventory status records. The formula is as follows:

Net requirements = Gross requirements - [Inventory on
hand - safety stock - Inventory
allocated] [Ref. 14]

If net requirements are greater than zero, lot sizes are ordered with these being offset to allow for lead times at each step in the production process and supplier lead times. This is considered to be a push system because end items are pushed out by materials ordered and processed at an early date.

MRP II, by design, only determines what is needed, when it is needed, and in what quantities. However, it may not necessarily be a panacea for all manufacturing industries, especially where repairable items are concerned. With repairables, one simply doesn't know how much to order under MRP II. If defects are discovered during the process, we have no way of knowing how many items will be capable of being repaired or how many will be beyond the capability of repair. This, in addition, makes it difficult to determine the amount of work capacity that will be required. Statistically speaking, we could only make approximations to determine the number of components to purchase and the amount of work capacity associated with repairable items.

2. Just-In-Time Production

Just-In-Time (JIT) production was first developed as a component of the Toyota Production System by Mr. Taiichi Ohno. JIT is a philosophy that says a manufacturer should produce only what the market demands, only as it's needed. The objective is to have only the correct part in the correct

place at the correct time. Just-in-time has definitely changed the way the inventory management environment functions.[Ref. 14]

The JIT production method accomplishes four primary objectives:

1. The lead time to produce a part is significantly reduced.
2. There are no surplus or "lost parts" which may have to be discarded.
3. Expediting is not required as all parts are "visible," in process, at all times.
4. Holding costs and the amount of capital tied up in work-in-process inventory are drastically lowered because of low inventory levels.[Ref. 14]

In order to accomplish the above objectives, a "pulling system" is used. Each stage in the production process draws, "pulls," just the right amount of inventory from the preceding process to keep it going. During the process all production controls are keyed on the final assembly line. All work centers feeding final assembly are connected in a chainlike fashion. This enables the entire production process to become synchronized with final assembly.[Ref. 14]

A Kanban system of inventory control is the means utilized to accomplish the just-in-time production process. Material flow control is accomplished by using a card called a kanban. The type of information contained on the card is

part number, name, provider's location, user's location, quantity per container, container number, and total number of containers for that part. Most kanban cards utilized today are permanently attached to their containers.[Ref. 17]

Once a container-with-card arrives from the maker (supplier) of the item, the user begins using up the contents. The time required to empty the container varies considerably. It might take an hour to empty a container or it could possibly take a week. But as soon as it is emptied, the container-with-card goes back to the maker, which is the signal to make and forward another one.[Ref. 15]

The containers circulate with identifying kanban attached; they circulate rapidly when the use rate is high and slowly when the use rate is low; they stop if there is no demand for a certain part for awhile. This, therefore, allows the card method to respond to the user's speedups and slowdowns. Both the number of containers in the flow and the number of units per container are fixed. These numbers are usually set arbitrarily, keeping in mind the JIT philosophy of minimal idle inventory and delay.[Ref. 15]

Three critical objectives must be achieved for successful implementation of the just-in-time system. First, the schedule for each day must be nearly identical. Second, the production process, the equipment utilized, and work spaces must be arranged and designed to provide a smooth

material flow. To accomplish this objective, one must reduce both setup and changeover times for one operation to another and utilize Yo-i-don. Redesign of machinery, tooling, and manufacturing processes, along with prepositioned changeover kits are means of achieving a reduction in setup and changeover times.[Ref. 14]

Yo-i-don is defined as the coordinated production of parts into subsequent assemblies. Each work station strives to complete its task in a given time window so delays are minimized or eliminated. A light panel called Andon is used to keep track of material flow. Whenever an operation is having difficulties, its respective light comes on and operators from other stations will assist in alleviating the difficulty. This usually entails job standardization and additional training for workers that are qualified to work efficiently at different operations.[Ref. 14]

The final objective, defect-free production, is one that all workers collectively must achieve. Being that Just-In-Time production is highly dependent on the flow of parts without delay, any disruption caused by a defective part causes major problems. Autonomation, the routine identification of defects in the production process, is normally used to accomplish this goal. This can be in the form of automatic inspection devices or inspection by workers themselves.[Ref. 14]

The workers, in this system, are responsible for inspecting their own work as well as that done by others on preceding stations. Jidoka, a term utilized for the production warning system, becomes operational whenever a defect is spotted. A switch triggers the Andon panel located above the production floor. A red light alerts the work force to a problem and the process is shut down until the situation is corrected. It automatically becomes the responsibility of everyone in the vicinity of a work station to correct the problem whenever the Andon is lighted.[Ref. 14]

There are several benefits associated with the successful implementation of a just-in-time system:

- Inventory levels are drastically reduced.
- Lead time is minimized. This enables the system to react more quickly to changes.
- Product quality is improved and discard costs reduced.
- Production is streamlined and relatively problem-free, because of the focus on problem solving.
- Management and the work force are unified in striving toward an established goal.[Ref. 14]

The negative aspects of just-in-time focus on the fact that the requirements of the system create obstacles which can block JIT implementation. The roadblocks and percentage of companies that have experienced, or expect to experience, these obstacles are: organizational resistance (77%), lack of systems support (78%), manufacturing constraints (74%), poor

quality of purchased goods (69%), inability to define service levels (76%), and poor JIT implementation planning.[Ref. 18]

JIT principles require cooperation and interdependence among departments and between companies. In addition, JIT impacts all areas of a company's organization and requires a major culture change. These types of organizational changes can be difficult to adjust to for some companies. Despite the above difficulties, companies are continuing to plan for and implement JIT to gain the competitive advantage.

C. INVENTORY MANAGEMENT PRACTICES

Two consistent factors seem to characterize companies that are persistently striving for significant and sustained reductions in their levels of inventory. First, top management is dedicated to and insistent on bringing about operational change. Second, the companies are managing change by focusing on the entire business or operation cycle. The traditional concepts of business management are now being challenged. Companies no longer view decisions from a functional or single manager perspective, but rather in the context of a company as a whole.[Ref. 17]

In order to attain the goals of reducing inventory while maintaining customer service levels, companies have begun to utilize some of the following techniques:

- Simplifying the inventory handling and decision-making processes.
- Automating the processes where appropriate.
- Integrating processes both between the company and its suppliers, carriers, and customers, and within the company itself.
- Establishing controls in systems and operations.
[Ref. 19]

Automation in some way, shape, or form seems to be the first recommendation of management for most major problems confronting today's big business. But managers in companies who stress the importance of simplifying inventory and management processes believe that simplification of the inventory cycle should take place before automation. Automation, which is quite appropriate for a fine tuned organization, is simply not a cure for an inefficient operation. By analyzing many of the day-to-day decisions affecting inventory levels, such as the physical movement of inventory, processes are being simplified by eliminating unnecessary steps.[Ref. 17]

Automated Data Processing (ADP) does in fact produce many benefits for many companies in the areas of control, accuracy, and even day to day management. This is especially true for companies transacting business on a worldwide scale. The development of an integrated inventory management system, capable of supporting such functions as purchasing, receiving and incoming quality control, warehousing, transportation, and

requirements planning, is considered by most large companies as vital to the success of the organization.[Ref. 17]

Automation and communication technologies are helping to centralize requirements determination, which in turn leads to lower stocking levels. Many private sector firms are also improving their material handling functions (receipt, storage, and issue) through automation, when it's practical to do so.[Ref. 17]

Many companies today have found that one key technique for improving inventory flow is better coordination of inventory management functions both within the company and between the company and its suppliers, carriers, and customers. Efforts of this nature usually result in long term gains such as improved relationships with suppliers, formalized integrated planning within the company, and clearly assigned responsibility for inventory levels within the company[Ref. 17]

Most of the operations managers in private industry seek to reduce inventory while maintaining or improving service levels. Since inventory is usually affected by the decisions of various functional managers in the areas of manufacturing, engineering, marketing, finance, and accounting, many companies have begun to establish integrated planning processes to minimize inventory levels while maintaining its operating service goals. This process is usually a formal one

that routinely brings together the separate functional managers to plan for the future.[Ref. 17]

Many companies in industry feel that in order to provide operating discipline and to hold individuals and groups accountable, they must have some type of performance measurement system integrated with the inventory management process. For example, some companies are using measures such as dock-to-stock time, inventory turnover rate, and order fill rate to monitor the performance of their materials flow process.[Ref. 17] There are many types of performance measures being utilized at all levels of the corporate ladder. These measures are designed to ensure all parties concerned that everyone in the organization is working as efficiently as possible, while remaining focused on the organizations goals.

D. ANALYSIS

Although there are differences in the inventory management systems and management techniques used between the private sector and DoD, the fact remains, that the ultimate goal of reducing and sustaining minimum levels of inventory, while maintaining or improving customer service levels is something we now have in common. The reasons for holding inventory and the strategies used to manage it have always differed between DoD and industry. The military services basically hold inventory to support missions with no-fail objectives. Thus, the military perspective is the more inventory DoD has, the

more sustained our military capability is to meet our no-fail objective.

The private sector, on the other hand, holds inventory in support of future sales with a profit objective. Since excess inventories can be a drain on profits, more and more companies have established goals to keep inventories to a minimum so as to improve profits. Granted, private industry is roughly ten years ahead of DoD in its thinking, nevertheless, the Department of Defense can still improve inventory management by utilizing private sector concepts and procedures.

Both Just-In-Time and MRP II (to a lesser degree) have proven themselves to be effective in private industry. As with any system, there are advantages and disadvantages associated with using one or the other depending on the use intended. MRP II, for example, is an excellent materials requirements planning system which can be used to order materials and track work in process inventory through the production cycle. But unfortunately, this is about its only positive attribute.

The MRP II systems primary drawback is that it is severely lacking in the controlling and scheduling of production to minimize work-in-process inventories and lead times. Just-in-time, on the other hand, is an inventory control technique that many in the highest levels of the Department of Defense believe will increase efficiency and productivity in the management of the military's multibillion dollar repair parts

(spares) programs [Ref. 20]. So, what's DoD going to do? DoD has been and is continuing its efforts to find a solution to this seemingly insurmountable problem.

The Navy, in particular, has begun utilizing expertise from the private sector to improve its management of inventory. Companies like Dupont de Nemours EI & Co., Ford Motor Co., and Sears are sharing inventory management practices with the Navy in such areas as receipt-stow-issue, security, receipt, confirmation, and material in transit.[Ref. 16] In addition to the systems and techniques covered in this study, there are many other planning and analysis techniques used by private industry such as Distribution Requirements Planning (DRP), Segmentation Analysis, and Value-Added Warehousing. DoD and its subcomponents are faced with the difficult task of choosing the best or most appropriate system (or mix of systems) which will meet its force objectives in the most cost-effective manner possible.

V. CONCLUSIONS AND RECOMMENDATIONS

This thesis has attempted to provide sufficient background information on the Department of Defense (DoD) Inventory Reduction Plan, to make an evaluation of its implementation effects on Naval inventory management practices at an Inventory Control Point, and on readiness at a Naval Aviation Depot (NADEP). The Aviation Supply Office (ASO) in Philadelphia, PA and NADEP Alameda were the two activities chosen for this study. In addition, an assessment was made of inventory control systems and management techniques currently being utilized in the private sector to reduce inventory levels.

The primary objectives of the DoD Inventory Reduction Plan (IRP) are to minimize the quantity of new items entering the supply system, reduce the number of items currently in the system, reduce the quantities of material stocked, pursue commercial alternatives to material stockage, and improve material control and asset visibility. All DoD components are responsible for reducing current levels of secondary item inventories and/or their associated costs.

As an inventory control point, ASO has been tasked to reduce its FY 93-97 Navy Stock Fund expenditures by \$1.936 billion. ASO, in response, has implemented a five year savings plan that will ultimately reduce costs and lower the

level of spare parts previously being supplied for fleet support. The plan is designed to shorten procurement lead times by employing better planning techniques, improve the reliability of systems and equipments via a strong VECP program, and utilize competitive buying on a regular basis. From all indications, ASO is meeting the challenge of inventory or cost reduction head on.

NADEP Alameda is currently plagued with material shortages. There are work stoppages, work-arounds, and other administrative problems such as rescheduling and planning. The production divisions handle the majority of the above problems largely by diverting RFI parts from one inventory to another. Another method is to backrob a part from a unit which is not operational to allow another unit to become so.

Actions such as these at the NADEPs only serve to temporarily sustain production, and they do have costs associated with them. The material shortage problems that appear to have the greatest effect are ones of material availability rather than slow local delivery. One thing is for certain, the Navy definitely needs to review its investment in unserviceable components. The savings that could be generated from returning these assets to the supply system as RFI units would be tremendous.

The question of implementing a Just-In-Time inventory method on a DoD-wide basis has yet to resolved. The ideal operating environment for JIT is one where there is limited

fluctuation in supply and demand, such as in a scheduled manufacturing process; the supplier is geographically close, and close cooperation and communication are characteristic; supplies are in small lots, and frequent deliveries are made; and safety stock is considered excess.[Ref. 19]

The traditional DoD procurement, distribution, and consumption environment has the following characteristics:

- Demands are unpredictable due to variable mean-time-between-failure and operational tempo
- Proximity and identity of the supplier may change each year or with each new contract.
- There is significant administrative burden, such as the requirements prescribed by the Federal Acquisition Regulation (FAR) and DoD procurement regulations.
- Often supplies are in large lots and small quantities, and deliveries are infrequent due to budget constraints and regulatory restrictions.
- Safety stock is required for lead time and deployment readiness requirements.[Ref. 19]

A comparison of the operating environment for successful JIT implementation and the current operating environment of the DoD inventory management program suggests that the two are incompatible. Low inventory could result in more efficient management of some items, but it would not be effective for managing many critical items. If an inventory management system for critical repair parts fails, it could result in zero balances, or even worse, mission failure. DoD components

can't afford to be purely "efficient" at the expense of a mission.

Although there are substantial differences in the inventory management systems and techniques used between DoD and the private sector, the military will greatly benefit by learning and applying certain industry management concepts. Techniques such as integrating processes between suppliers and customers, establishing controls in systems and operations, and simplifying the inventory handling and decision-making processes are all achievable concepts. Private industry seems is willing to share its ideas. The military needs to take the next step and learn to apply the concepts.

A. RECOMMENDATIONS FOR FUTURE WORK

This study has shown that the overall effect of the DoD Inventory Reduction Plan, at this point, has been both beneficial in some respects and detrimental in others. The fact that ASO is now working smarter to save dollars, does not alleviate the material shortage problems confronting the NADEP. Quite the contrary, ASO may only be compounding the problem as they will be purchasing even fewer spare and repair parts for future fleet support.

The success or failure of the DoD Inventory Reduction Plan is extremely difficult to determine at such an early juncture. It is this researcher's opinion that the answer, as in most cases in dealing with DoD, will only be known in time. The

lack of statistical data and empirical information available, concerning the impact of the IRP on the Navy supply system, indicates that the total DoD-wide system impact is not, as of yet, being taken into consideration. This raises the question of whether the system is being properly served, and probably requires further research.

Additional work or research in the following areas would be beneficial:

1. What can be done by the Navy to improve material availability for aviation components?
2. What has been the effect of the IRP on the Ships Parts Control Center (SPCC) and how has it effected the way they are currently doing business?
3. How can the Navy best integrate diverse information sources (such as Inventory Control Points, Naval Supply Centers and the Navy Industrial Fund store) so it can better analyze material problems?
4. What is the effect of the IRP on levels of service three to five years from now? Have inventory levels actually been reduced?
5. What is the total effect of the IRP program on the DoD-wide Supply System?

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